

New species of *Iarupea* Martínez and morphological specializations among related taxa associated with ants and termites (Coleoptera: Scarabaeidae: Eupariini)

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New species of *Iarupea* Martínez and morphological specializations among related taxa associated with ants and termites (Coleoptera: Scarabaeidae: Eupariini). - *Iarupea* Martínez is one of the South American, myrmecophilous genera of Eupariini with five species, including two species from Brazil described herein as new: *I. goias* sp. n. and *I. luisae* sp. n. The genus is redefined, a key for species, distribution, habitus photographs and illustrations are given. Adaptive modifications in external morphology of *Iarupea* and of 14 related myrmecophilous genera are summarized. Of the total number of 33 species known to occur with social insects, most numerous species are recorded in association with leaf-cutting ants *Atta* F. (18 species) and *Acromyrmex* Mayr (5 species); the second group includes species associated with fire ants *Solenopsis* Westw. (7 species) and *Iridomyrmex* Mayr (1 species) (Formicidae, Myrmicinae). Two highly derived species are recorded from termitaria of unknown hosts. Known or suspected behavioural aspects among the guests and hosts are discussed.

Keywords: Coleoptera, - Eupariini - *Iarupea* - new species - myrmecophilous genera - morphological specializations - New World.

INTRODUCTION

Myrmecophily or myrmecophoby is wide-spread among Coleoptera and has, in some groups, led to remarkable modifications in the external morphology. Myrmecophilous tendencies among the Neotropical Scarabaeinae and Coprinae were documented in the literature several times (Vaz-de-Mello *et al.*, 1998) while only few studies focused on the association of the Eupariini with social insects (Woodruff & Cartwright, 1967; Wojcik *et al.*, 1977, 1978). This paper represents an initial attempt to bring together all available information on the New World myrmecophilous Eupariini and their morphological specializations. *Iarupea* Martínez (1952) is a small genus with five South American species, including two new species from Brazil described herein. This originally monospecific genus was diagnosed by Stebnicka (1999a) who added to it two distinctive species transferred from *Euparia* Le Peletier Saint Fargeau & Serville. The discovery of the following two species of *Iarupea* and

examination of additional material enabled to emphasize the most striking morphological modifications in external morphology of 15 genera containing 33 myrmecophilous and termitophilous species. Members of the genera presented in Table 1 are poorly represented in the majority of the entomological collections, almost certainly due to their inquiline habits. Of the total number of 33 species, 23 species are associated with Attini, 8 species with Solenopsidini (Formicidae, Myrmicinae) and two species are recorded from termitaria.

MATERIALS AND METHODS

The nomenclature used in this paper to describe external features follows that of Chapin (1940), Cartwright (1974) and somewhat modified terminology of Stebnicka & Howden (1996, 1997).

This study is based on the primary types of all known species and on material collected in South America and submitted for identification. The type material and other specimens studied may be found in the following repositories: Canadian Museum of Nature, Ottawa, Canada (CMNO); Florida State Collection of Arthropods, Gainesville, USA (FSCA); Hungarian Natural History Museum, Budapest, Hungary (HNHM); Institute of Systematics & Evolution of Animals, Krakow, Poland (ISEA); Muséum d'histoire naturelle, Geneva, Switzerland (MHNG); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Staatliches Museum für Tierkunde, Dresden, Germany (SMTD); National Museum of Natural History, Smithsonian Institution, Washington DC, USA (NMNH); Zoologisches Museum für Naturkunde der Humboldt Universität, Berlin, Germany (ZMHB).

The most numerous specimens, particularly those from Antonio Martínez collection are deposited in the Canadian Museum of Nature, Ottawa (CMNO).

TAXONOMY

Genus *Iarupea* Martínez, 1953

Iarupea Martínez, 1953: 75-77.- Stebnicka 1999a: 290-291.

Euparia Le Peletier de Saint Fargeau & Serville, 1828: 357 (in part)

Iarupoides Chalumeau & Howden, 1984: 87 (nomen nudum).

TYPE SPECIES: *Iarupea lopeteguii* Martínez, by monotypy.

DIAGNOSIS: morphological modifications. Head with coarse longitudinal wrinkles, genae sharply carinate in front of eyes. Pronotum furrowed basally with wide marginal collar and postero-lateral cavities to receive elytral lobe, anterior angles concave and slightly transparent. Elytra with humeral angles prolonged anteriorly into dentiform lobes (Fig. 6), apices of lobes with microtrichomes. Legs long; middle and hind tibiae slender, very narrow at base and weakly expanded apically.

REDESCRIPTION: length 4.5- 5.0 mm. Body (Figs 1, 3-5) elongate, alutaceous, usually covered with argillaceous coating. Head moderate in size, convex medially, genae right-angled. Eyes invisible from above; antennae 9-segmented, club ovoid, 3-segmented; mouthparts adapted to soft saprophagy. Pronotum strongly convex on disc, sides narrowly explanate and sinuate to obtuse posterior angles, side margin with fringe of short, very close, club-shaped setae. Scutellum subtriangular, depressed.

Elytra narrower than pronotum, base margined and swollen, usually with large tubercles terminating intervals 3, 5, 7; intervals convex, crenate by strial punctures; epipleura oblique, reduced anteriorly, narrowed toward apex. Metathoracic wings well developed. Prosternum with triangular process; mesosternum declivous toward metasternum; mesocoxae separated, space between mesocoxae equal to width of mesofemur, meso-metasternal carina inconspicuous or lacking; metasternum long, convex; abdominal sternites fused; pygidium large, disc eroded. Profemur wide, anterior margin fringed with row of truncate setae, posterior margin widely flattened; middle and hind femora long, parallel-sided, without postfemoral lines; fore tibiae narrow, relatively short, third lateral tooth very small; middle and hind tibiae slender, apical spurs thin, slightly arcuate; tarsi shorter than tibiae, tarsomeres slender, claws fine, hornlike. Epipharynx specifically not differentiated.

MALE: terminal spur of fore tibia bent inwardly at the tip; penultimate abdominal sternite shorter and less arcuate than in female; genitalia specifically weakly differentiated, aedeagus elongate, parameres slender, as long as phallobase or slightly longer (Figs 9, 10).

FEMALE: pronotum more convex than in male; terminal spur of fore tibia straight; penultimate abdominal sternite longer than in male and slightly arcuate medially.

DISTRIBUTION: South America (Fig. 7); includes all previously published localities.

REMARKS: the unique combination of autapomorphic character states distinguishes *Iarupea* from all other genera of Eupariini. The genus is most close to *Arupaia* Stebnicka, sharing with that genus a similar overall appearance, sculpture of the head and pronotum and the elytra with humeral lobes. *Iarupea*-species are known to occur with leaf-cutting ants of the genus *Atta* F. (Table 1).

KEY TO SPECIES OF *IARUPEA*

- 1 Pronotum with fine, uniformly distributed granules (Fig. 6), basal collar smooth; elytral intervals 3, 5, 7 carinate basally. Brazil *goias* sp. n.
- Pronotum with coarse pits or irregular wrinkles, basal collar longitudinally strigose; elytral intervals 3, 5 tuberculate or carinate basally 2
- 2 Pronotum with coarse, longitudinally confluent wrinkles (Fig. 2); elytral striae with punctures strongly crenating intervals on each side. Bolivia, Brazil, Paraguay *serratipennis* (Petrovitz)
- Pronotum with coarse punctures or pits; elytral striae with punctures crenating inner margins of intervals 3
- 3 Base of pronotum on each side of collar with prominent tubercle, pronotal surface with coarse, rough, nearly contiguous pits; lateral intervals of elytra finely closely punctate. Argentina, Bolivia, Paraguay . *lopeteguii* Martínez
- Base of pronotum on each side of collar slightly convex without prominent tubercle, pronotal surface differently sculptured; lateral intervals of elytra impunctate 4

- 4 Pronotal punctures or pits round or slightly elongate, separated by about one their diameter; elytral intervals 5, 7 carinate basally. Brazil *attenuata* (Harold)
- Pronotal punctures or pits elongate, nearly contiguous, tending to coalesce into longitudinal lines; elytral intervals 3, 5 with tubercle basally. Brazil *luisae* sp. n.

***Iarupea lopeteguii* Martínez**

Figs 7, 10

Iarupea lopeteguii Martínez, 1953: 77-80, fig. 9; Stebnicka 1999a: 292, fig. 5.

MATERIAL EXAMINED: Holotype and 4 paratypes (Argentina, Prov. Formosa, Puerto Irigoyen, Rio Pilcomayo) in CMNO. Other specimens (28): ARGENTINA – (14 ex) Prov. Salta, Dpto Gen. Ballivian, 1927, leg. Harrington; (2 ex) Dpto Gen. San Martin, Politos, XI.1950; (1 ex) Dpto Anta Las Lajitas, XII.1984; (2 ex) NS Telavera, XI.1957, coll. Martínez (CMNO, MHNG); (1 ex) Dpto Tartagal, 12-19.XII.1990, M. Archangelsky (ISEA, NMNH). BOLIVIA – (1 ex) Villa Montes at Rio Pilcomayo, 1-29.XI.1930, S.G. Eisenstraut (ZMHB); (4 ex) Santa Cruz, P. Cordillera, Cabezas, II.1971, coll. Martínez (CMNO). PARAGUAY – (3 ex) Dpto Boqueron, Gran Chaco, XI.1956, coll. Martínez (CMNO).

DIAGNOSTIC CHARACTERS: colour dark reddish brown; clypeal margin slightly reflexed, truncate anteriorly; surface of head with longitudinal wrinkles broken into irregular segments and with extremely short setae visible under high magnification. Pronotum convex medially, basal collar longitudinally strigose with sharp tubercle on each side; surface roughly sculptured, with large, very close, sharply edged pits bearing minute setae. Elytra parallel-sided, humeral lobes moderately long; striae impressed, stria punctures transversely crenate margins of intervals; intervals slightly convex, strongly microreticulate and minutely punctured, punctures on lateral intervals very close, 5th interval at base with large, conical tubercle. Ventral sclerites alutaceous, minutely punctate, covered with extremely short, upright setae; abdominal sternites 1-4 finely fluted along sutures, sternite 5 with longer and coarser fluting; eroded disc of pygidium longitudinally wrinkled, margin upturned. Profemur wide, perimarginal groove lacking, surface finely granulate and setigerous. Basal tarsomere of hind tarsus slightly longer than upper spur of tibia and longer than following three tarsomeres combined.

REMARKS: the species is most closely related to *Iarupea serratipennis* but may be easily recognized by the characters given in the key. Several specimens were collected to black light traps and found in the nest gallery of *Atta vollenweideri* Forel (Martínez, 1953).

***Iarupea serratipennis* (Petrovitz)**

Figs 1-2, 7, 8-9

Euparia serratipennis Petrovitz, 1973: 185-186.

?*Euparia serratipennis*: Chalumeau & Howden, 1984: 88.

Iarupea serratipennis: Stebnicka 1999a: 292, fig. 6.

MATERIAL EXAMINED: Holotype (Brazil, Minas Gerais) in MHNG. Other specimens (106): ARGENTINA – (2 ex) Prov. Misiones, Iguazu, XII.1957, coll. Martínez (CMNO). BOLIVIA – (1 ex) Prov. Sara, coll. Steinbach (ZMHB); (1 ex) Prov. Santa Cruz, XII.1971, IX.1972, F. Plaumann (CMNO); (2 ex) Guayaramirim (Beni), 23. XI.1966, Hungarian Zool. Soil Exp, leg. Balogh & Mahunka & Zicsi (HNHM, ISEA). BRAZIL – (3 ex) (MS) Mato Grosso do Sul, Selviria, UNESP Farm, 18.III.1999, C. Flechtman; (2 ex) (Ro) Rondonia, 62 km SW Ariquemes, near Faz. Rancho Grande, 25.IX.1992, U. Schmitz (FSCA); (1 ex) (Ma) Maranhão,



FIGS 1-6

(1) *Iarupea serratipennis* (Petrovitz): habitus of female; (2) same, sculpture of pronotum; (3) *I. attenuata* (Harold): habitus of male; (4) *I. luisae* sp. n.: habitus of paratype female; (5) *I. goias* sp. n.: habitus of holotype female; (6) same, detail of pronotum and elytra.

Pedrinhas, 26.VI.1984, C. Flechtmann (ISEA); (1 ex) (MT) Mato Grosso, Xingu, XI.1963; (1 ex) (ES) Espirito Santo, Linhares, XI.1962, coll. Martinez (CMNO); (90 ex) (Sc) Santa Catarina, Nova Teutonia, XII.1972, F. Plaumann (CMNO). PARAGUAY – (1 ex) Puerto P. Stroessner [=Ciudad del Este], 5-6.I.1966, leg. Mahunka (MHNG); (1 ex) Villarica, 25 km E Independencia, 21.I.1991, S. Endrödi-Younga (ISEA).

DIAGNOSTIC CHARACTERS: body (Fig. 1) rusty brown to dark brown, weakly shining. Clypeal margin broadly rounded on each side of shallow median emargination; surface of head with coarse, contiguous longitudinal wrinkles. Pronotum convex medially, basal collar longitudinally strigose, anterior angles concave and slightly transparent; surface strongly swollen with irregular coarse wrinkles (Fig. 2). Elytra parallel-sided, humeral lobes moderately long; striae impressed, stria punctures coarse, transversely crenate margins of intervals; intervals slightly convex or flat, intervals 3, 5 with tubercle basally, surface minutely punctate. Abdominal sternites equally, distinctly fluted along sutures; eroded disc of pygidium longitudinally strigose, margin upturned. Profemur wide, perimarginal groove fine, surface finely granulate. Basal tarsomere of hind tarsus longer than upper spur of tibia and longer than following three tarsomeres combined. Epipharynx as in Fig. 8. Male genitalia as in Fig. 9.

REMARKS: the species shows an advanced variation in the proportions and sculpture of the body. It is closest to *Iarupea lopeteguii*, but differs from that species by its more robust body and sculpture of the pronotum. Even though *I. serratipennis* is represented by the greatest number of specimens, most of them were collected to black light traps; several specimens were taken from the nests of *Atta sexdens* (L.).

Iarupea attenuata (Harold)

Figs 3, 7

Euparia attenuata Harold, 1870: 23-28; Schmidt 1922: 397.

Iarupoides attenuatus: Chalumeau & Howden, 1984: 87.

Iarupea attenuata: Stebnicka, 1999a: 291-292, fig. 11.

MATERIAL EXAMINED: Lectotype "Brazil" (designated by Cartwright, 1973) in MNHN. Other specimens (17): BRAZIL - (2 ex) (Pe) Pernambuco (SMTD); (9 ex) (Pa) Pará, Jacareacanga, X.1959, coll. Martinez (CMNO, MHNG); (2 ex) (MG) Minas Gerais, Cordisburgo, Faz. Pontinha, VII.1974, F. Vaz-de-Mello (ISEA); (3 ex) (Sc) Santa Catarina, Nova Teutonia, X.1963, F. Plumann; (1 ex) (ES) Espírito Santo, Linhares, X.1968, M. Alvarenga (NMNH).

DIAGNOSTIC CHARACTERS: body (Fig. 3) piceous, in some specimens with slight blue lustre, weakly shining. Clypeal margin broadly rounded on each side of shallow median emargination; surface of head with coarse, contiguous longitudinal wrinkles. Pronotum convex medially, basal collar longitudinally strigose; surface with irregularly spaced, coarse, circular or slightly elongate punctures or pits separated by one to three times their diameters. Elytra parallel-sided, humeral lobes moderately long, ended by microtrichomes; striae impressed, stria punctures coarse, transversely crenate only inner margins of intervals; intervals slightly convex or flat, minutely setigerous apically, intervals 5, 7 carinate basally. Abdominal sternites equally, finely fluted along sutures, eroded disc of pygidium longitudinally strigose, margin upturned. Profemur wide, perimarginal groove fine, surface finely granulate. Basal tarsomere of hind tarsus longer than upper tibial spur and longer than following three tarsomeres combined.

REMARKS: the species is most closely related to *Iarupea luisae* sp. n. (see Remarks under that species). As indicated on the labels, some specimens of *I. attenuata* were taken from detritus cavities of the nests of *Atta sexdens* (L.).

Iarupea luisae sp. n.

Figs 4, 7

TYPE MATERIAL: Holotype female, Brazil, (Ma) Maranhão, Pedrinhas, São Luis Island, 29.VIII.1999, black light trap in mangrove area, E.C. Bergmann, in ISEA. Paratype female, same locality as holotype, "ex *Atta* sp. dump", in ISEA.

DESCRIPTION OF FEMALES: length 4.8-5.0 mm. Body (Fig. 4) piceous to black, weakly shining. Clypeal margin broadly rounded on each side of shallow median emargination; surface of head from anterior margin to frons with coarse, contiguous longitudinal wrinkles blending into vertical band of round, close punctures separated by about one their diameter. Pronotum convex medially, diverging posteriorly, anterior angles slightly transparent, sides widely grooved and upturned, fringed with very close, short, club-shaped setae, basal collar longitudinally strigose; pronotal surface excluding lateral groove with coarse punctures or pits tending to coalesce into longitudinal lines. Elytra parallel-sided, humeral lobes rather long, ended by microtrichomes; striae impressed, stria punctures coarse, transversely crenate margins of intervals; intervals slightly convex on disc, deplanate laterally, intervals 3, 5 with tubercle basally, surface microreticulate, impunctate. Ventral surface alutaceous; prosternal process widely triangular; mesosternum lower than metasternum with shallow, fine punctures separated by about one their diameter, posteriorly punctures scattered toward metasternum; meso-metasternal carina lacking; metasternum convex, midline impressed, discal punctures minute, scattered, lateral metasternal triangle broad, shallow, lateral area opaque, impunctate; abdominal sternites glabrous, impunctate with extremely fine fluting along sutures; pygidium broad, disc eroded, longitudinally strigose with upturned margin. Profemur with perimarginal groove and fringe of truncate setae, surface everywhere finely granular; middle and hind femora long, parallel-sided, smooth; middle and hind tibiae as long as femora, very slender and thin at base, apex fringed with 6-7 short setae, apical spurs slender, arcuate; basal tarsomere of hind tarsus subequal in length to upper spur of tibia and longer than following three tarsomeres combined.

MALE: unknown.

REMARKS: *Iarupea luisae* is most similar to *I. attenuata* from which it differs by having the pronotum broader with coarser and closer pits forming longitudinal lines.

ETYMOLOGY: named after the type-locality.

Iarupea goias sp. n.

Figs 5-6, 7

TYPE MATERIAL: Holotype female: Brazil, (Go) Goiás, Mun. Bela Vista de Goiás, Cristianópolis, Fazenda Arapuça Velha, 21.IX.1993, *Atta* sp. nest gallery, A. Bankovics, in HHNM.

DESCRIPTION OF FEMALE: length 5.0 mm. Body (Fig. 5) castaneous, glabrous, weakly shining. Clypeal margin broadly rounded on each side of shallow median emargination; clypeal surface along anterior margin slightly concave and finely punctate, median convexity to frons with coarse longitudinal wrinkles blending into vertical band of round, fine, close punctures separated by less than one their diameter. Pronotum convex medially, diverging posteriorly, anterior angles slightly transparent, sides widely grooved and upturned, fringed with very close, short, club-shaped setae,

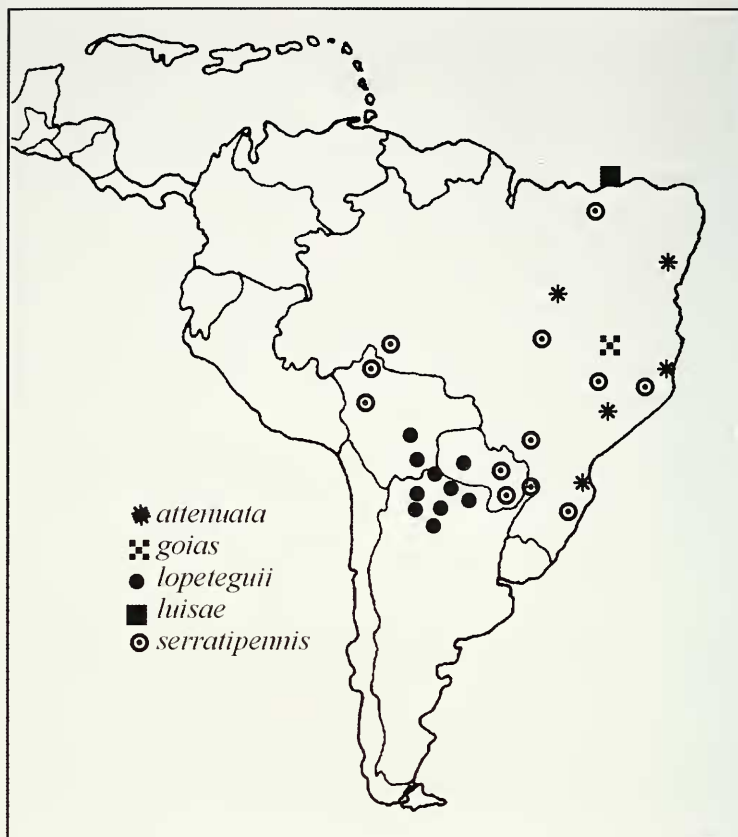
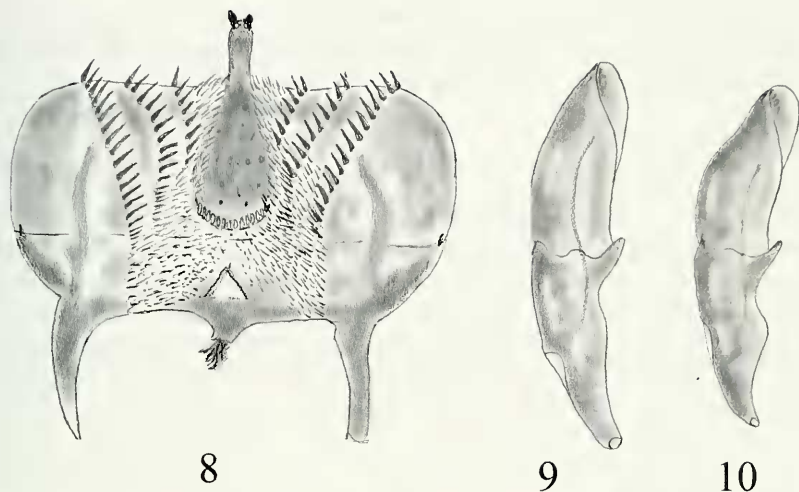


FIG. 7
Distribution of *Iarupea* species

basal collar wide, smooth like as lateral groove, pronotal surface finely granulate, granules separated by one their diameter or nearly so. Elytra slightly arcuate, humeral lobes rather long (Fig. 6) ended by microtrichomes; striae impressed, stria punctures coarse, transversely crenate margins of intervals; intervals slightly convex on disc, deplane laterally, intervals 3, 5, 7 obtusely carinate basally. surface microreticulate, impunctate. Ventral surface alutaceous; prosternal process triangular; mesosternum lower than metasternum, finely punctate in anterior third, punctures posteriorly become longitudinal, shallow, tending to coalesce into lines; meso-metasternal carina lacking; metasternum convex, midline impressed, discal punctures minute, scattered, lateral metasternal triangle broad, shallow, lateral area opaque, impunctate; abdominal sternites glabrous, impunctate with extremely fine fluting along sutures; pygidium broad, disc eroded, longitudinally strigose with upturned margin. Profemur with perimarginal groove and fringe of truncate setae, surface finely punctate; middle and hind femora long, parallel-sided, smooth; middle and hind tibiae as long as femora, very slender and thin at base, apex fringed with 5-6 short setae, apical spurs slender,



FIGS 8-10

(8) *Iarupea serratipennis* (Petrovitz): epipharynx; (9) same, male genitalia in lateral view; (10) *I. lopeteguii* Martínez: male genitalia in lateral view.

arcuate; basal tarsomere of hind tarsus longer than upper tibial spur and equal in length to following three tarsomeres combined.

MALE: unknown.

REMARKS: I decided to describe this species on the basis of a single specimen, because its remarkably distinctive features are diagnostic. *Iarupea goias* sp. n. differs from all other species in the genus by its unusual sculpture of the pronotum (Fig. 6).

ETYMOLOGY: named after the type-locality.

RELATED GENERA AND THEIR MORPHOLOGICAL SPECIALIZATIONS

Euparia Le Peletier de Saint Fargeau & Serville, 1828: 357, et Auctt.- Chalumeau & Howden 1984: 85-87.

DISTRIBUTION: Southern United States, Central America, Venezuela, West Indies.

The numerous, world-wide species originally assigned to this genus have been transferred to the other existing or newly described genera (Stebnicka & Howden, 1996). *Euparia* includes presently three species (Chalumeau & Howden, 1984) characterized by following morphological modifications: head broad; clypeal and prothoracic indentations forming a cavity to receive appendages and fore legs; pronotum with sides explanate, setaceous; elytra with humeral angles prolonged anteriorly into dentiform lobe; middle and hind legs long, femora longer than tibiae; tibiae thin, narrowed at base. Hosts are known for two species:

Euparia castanea Le Peletier de Saint Fargeau & Serville, 1828 and *E. mirabilis* (Balthasar, 1945). These species are sympatric, very similar externally and difficult to

distinguish. Most likely both species were studied in USA by Wojcik *et al.* (1977) and taken from excavated nests of tropical fire ants *Solenopsis geminata* F. and southern fire ants *S. xyloni* McCook.

Arupaia Stebnicka, 1999a: 289.

DISTRIBUTION: Brazil.

Monospecific genus, closely related to *Euparia* and to *Iarupea*, sharing with both these genera some morphological modifications: head broad, surface longitudinally wrinkled; presence of clypeal and prothoracic cavities to receive appendages and fore legs; pronotum with basal collar and explanate sides; elytra with humeral angles prolonged anteriorly into dentiform lobe; middle and hind legs long and thin.

Arupaia friedenreichi (Harold, 1870) (Brazil) - collected in the nest of *Solenopsis geminata* F.

Selviria Stebnicka, 1999a: 287.- 2005a: 23-25.

DISTRIBUTION: Brazil.

The genus includes two species and seems to be most closely allied to *Euparia*. The unusual morphological modifications are: cuticle orange, strongly shining, smooth; head broad; sides of pronotum very widely explanate with upturned margin; elytral striae very fine; elytral margin narrowly explanate and upturned; mesosternum flattened, mesocoxae separate; legs very long, middle and hind tibiae thin, tarsal segments thick. Host is known for one species:

Selviria matogrossoensis Stebnicka, 1999a (Brazil) - one specimen found in the nest of *Solenopsis invicta* Buren.

Euparixia Brown, 1927: 288.- Woodruff & Cartwright, 1967: 6; Gordon & McCleve 2003: 685-686.

DISTRIBUTION: USA (Arizona, Louisiana), Cuba, Guatemala, Mexico, Panama.

The genus includes presently 10 species with following morphological modifications: clypeal margin inflexed; pronotum strongly constricted basally with sides explanate; elytral epipleurae covering episternum, epimeron and apices of elongated and widely separated mesocoxae; legs long, slender. *Euparixia* is most closely related to *Euparixoides* Hinton containing five cryptic species of unusual appearance (Stebnicka & Skelley 2005), however, nothing is known on their hosts associations. Six species have been recorded in association with ants:

Euparixia duncani Brown, 1927 (Arizona) - most likely associated with *Acromyrmex versicolor* Pergande and/or *Atta mexicana* Smith.

Euparixia moseri Woodruff & Cartwright, 1967 (Louisiana) - specimens taken from nest excavation (fungus garden central cavity and detritus cavity) of *Atta texana* (Buck).

Euparixia bruneri Chapin, 1940 (Cuba) - collected in the nest of *Atta insularis* Guérin known only from Cuba.

Euparixia formica Hinton, 1934 (Mexico).- collected in the nest of *Atta mexicana* Smith.

Euparixia costaricensis Hinton, 1936 (Costa Rica).- species associated with *Atta colombica* Guér. and *Atta cephalotes* (L.).

Euparixia campbelli Gordon & McCleve, 2003 (Guatemala) - collected in large detritus cavity of the nest of *Atta* sp.

Lomanoxia Martínez, 1951: 23-29.- Krikken, 1972: 70; Stebnicka, 1999c: 2; Skelley & Howden, 2003: 186.

DISTRIBUTION: Argentina, Brazil, Bolivia, Paraguay, Surinam, Costa Rica, Trinidad.

The genus includes five species with following morphological modifications: body egg-shaped; pronotal and elytral margins with row of long setae; elytra flattened and sharply inflexed at 8th interval forming a broad false epipleural fold, surface with prominent setation and with scale-like setae; mesocoxae widely separated; mesepisternum, mesepimeron and elongated mesocoxae hidden; legs long. Hosts are known for three species.

Lomanoxia costulata (Harold, 1867) (Brazil) - collected in Surinam from detritus cavities of the excavated nest of *Atta sexdens* (L.).

Lomanoxia alternata Krikken, 1972 (Surinam) - collected from detritus cavities of the excavated nest of *Atta cephalotes* (L.).

Lomanoxia canthonopsis Skelley & Howden, 2003 (Costa Rica) - found in refuse piles of *Atta cephalotes* (L.).

Flechtmanniella Stebnicka, 1999b: 287.

DISTRIBUTION: Brazil.

Monospecific genus closely related to *Lomanoxia*, sharing with that genus some morphological modifications: body shape oval; presence of clypeal and prothoracic indentations to receive appendages and fore legs; elytra flattened and sharply inflexed at 8th interval forming a broad false epipleural fold; mesocoxae widely separated; middle and hind tibiae short, expanded apically, tarsal segments short, thick.

Flechtmanniella laticollis (Petrovitz, 1973) (Brazil) - found in the nest of fungus growing ants *Acromyrmex lobicornis* (Emery).

Lomanoxoides Stebnicka, 1999a: 293-294.- Stebnicka & Skelley, 2005: 29.

DISTRIBUTION: Argentina, Bolivia, Brazil, Paraguay, Peru, Panama, Honduras.

The genus includes seven species having most of the morphological characters unmodified like as in the other free-living taxa of the tribe: body oblong oval, convex; pronotum usually with swellings; elytral intervals subcarinate or carinate at middle with row of fine setae. Hosts are known for two species:

Lomanoxoides nigrolineatus (Hinton, 1938) (Panama) - found in debris piles of *Atta* sp. and in refuse of *Atta colombica* Guér.

Lomanoxoides tesari (Balthasar, 1963) (Paraguay) - found in the nests of *Atta sexdens* (L.).

Paraplesiataenius Chalumeau, 1992: 194.- Stebnicka 2003a: 444.

DISTRIBUTION: Southeastern Brazil, Uruguay, Argentina.

The genus is closely related to *Lomanoxoides* and includes three *Aphodius*-appearing species with slightly modified morphological characters: body oblong oval, convex, shining; pronotal and elytral margins with row of setae; lateral elytral intervals at apex with short scarce setae; hind tibiae distinctly expanded apically. Hosts are known for all species of the genus:

Paraplesiataenius tremolerasi (Schmidt, 1911) (Argentina) – collected in Argentina in the nest of *Acromyrmex lobicornis* (Emery), in Uruguay found together with *A. lundii* Sant.

Paraplesiataenius catarinaensis Stebnicka, 2003a (Brazil) – collected in the nest of *Acromyrmex* sp.

Paraplesiataenius genieri Stebnicka, 2003a (Brazil) – found together with *Acromyrmex* sp.

Martineziella Chalumeau, 1986: 386.

DISTRIBUTION: Southern USA, Argentina, Paraguay, Uruguay, Bolivia, Brazil, Guiana, Mexico, Cuba, Dominican Republic.

The genus includes six species having most of the morphological characters unmodified like as in the free-living species of the tribe: body elongate, convex; pronotum with sides explanate, fringed with very close, truncate setae; legs long. Hosts have been recorded for two species:

Martineziella vandykei (Hinton, 1936) (Mexico) - paratypes were taken from the nests of “a small, red, biting ants” (Hinton, 1936); other specimens collected in detritus remnants of the nests of *Solenopsis invicta* Buren.

Martineziella dutertrei (Chalumeau, 1983) (Cuba) = *Myrmecaphodius excavaticollis* (non Blanchard, 1843): Woodruff, 1973: 101-102, fig. 212; Wojcik *et al.*, 1977: 329-334.

This species is widely distributed from southern USA to Argentina and occasionally very abundant. Collins & Markin (1971) reported this species from 98% of the fire ant nests they examined in the United States and they observed in the laboratory that the beetles in proximity to ants released a strong musky odour. A complete life cycle of the beetles apparently occurs in the nests where their preimaginal stages also have been found. *M. dutertrei* is known to occur in numerous nests of *Solenopsis invicta* Buren (red fire ant), *S. richteri* Forel (black fire ant), *S. geminata* F. (tropical fire ant), *S. xyloni* McCook (southern fire ant) and *Iridomyrmex humilis* (Mayr) (argentine ant).

Myrmecaphodius Martinez, 1952: 85.- Stebnicka 1999a: 292.

DISTRIBUTION: Argentina.

Monospecific genus related to *Martineziella*. Its morphological modifications are as follows: head coarsely longitudinally wrinkled; pronotum strongly convex, sides explanate in anterior half, basal margin strong, wide at middle with longitudinal costulae, pronotal surface with deep, large pits.

Myrmecaphodius proseni Martinez, 1952 (Argentina).- Stebnicka 1999a: 293 - type series (29 specimens) and other individuals examined were collected in the nest gallery of fire ants *Solenopsis saevissima* Smith.

Haroldiataenius Chalumeau, 1981: 137.

DISTRIBUTION: Southern United States, Mexico, Guatemala, Honduras.

About seven species are assigned to this genus (revision in preparation by Stebnicka). The morphological characters reveal a rather weak modifications: body oval, strongly convex; abdominal sternites and pygidium with row of blunt setae. Host is known for two species:

Haroldiataenius hintoni (Saylor, 1933) (Mexico) - collected in Guatemala in detritus remnants of the nest of *Atta mexicana* Smith.

Haroldiataenius limbatus (Bates, 1887) (Mexico) - found in Guatemala in "Atta sp. dump" (label data by J. Baster).

Ataenius Harold, 1867: 82, et Auctt.

DISTRIBUTION: Pantropical.

The genus contains presently about 190 species distributed throughout American continent and West Indies. The morphological characters of a number of species show some insignificant modifications, such as: head larger than usual; surface of body with rows of thick setae or cuticle coarsely, roughly sculptured (usually smooth or punctate); pronotal lateral margin fringed with close, truncate or club-shaped setae (usually setae are scarcer and slender); legs longer than usual; tarsal segments thick (usually slender). From among 190 species only two species are indicated in association with ants:

Ataenius holopubescens Hinton, 1938 (Mexico) - collected from detritus remnants in the nests of *Atta mexicana* Smith.

Ataenius variopunctatus Schmidt, 1922 (Argentina) - rare species known only from Buenos Aires. From among 6 specimens available to study one specimen was glued on card together with a specimen of ant and labeled "*Solenopsis* sp." by J. Daguerre.

Batesiana Chalumeau, 1983: 143-144.

DISTRIBUTION: Panama, Costa Rica, Brazil.

Monospecific genus with advanced morphological modifications: head very large; pronotum short and very broad; presence of clypeal and prothoracic indentations to receive appendages and fore legs; elytra strongly elevated medially, lateral and apical intervals with row of irregular tubercles (glands?); mesosternum deplanate, mesocoxae widely separated; fore tibiae short and narrow with two reduced lateral teeth; middle and hind tibiae short, strongly expanded apically, covered with dense hair; tarsi short and thick with long hair.

Batesiana tuberculata (Bates, 1887) (Panama) - collected in Brazil with "termite".

Napoa Stebnicka, 1999d: 290-291.

DISTRIBUTION: Ecuador.

Monospecific genus closely related to *Batesiana* with advanced morphological specializations: head very large; presence of clypeal and prothoracic indentations to

receive appendages and fore legs; elytra globular, lateral and apical intervals with row of irregular tubercles (glands?); mesosternum deplanate and calloused, mesocoxae widely separated; prosternum, mesosternum and mesocoxae with distinct pockets or cavities of possible mycangial function.

Napoa peckorum Stebnicka, 1999d (Ecuador) - specimens found in broken termite nest.

REMARK: the genus *Cartwrightia* Cartwright, was recently assigned to the tribe Eupariini by Skelley & Howden (2005) on the basis of some character states shared with *Lomanoxia*. Apart from the general appearance of *Cartwrightia* strongly resembling various genera of Rhyparinae, the shape of head and characters of mouthparts of biting type exclude this genus from the Eupariini. The biting type of mouthparts is one of the principal diagnostic characters for Aegialiinae, Aulonocneminae and Rhyparinae as well.

DISCUSSION

The members of fifteen euparine genera here considered (Table 1) are characterized by more or less advanced morphological specializations. Although they have no distinct trichomes, exudatoria or exocrine glands attractive to the ants, their external features are frequently unusual. Some species have retained a generalized appearance and differ little from their free-living relatives, while others seem to be highly derived. These species, like as all other members of the tribe, have the mouthparts of filtering type (adapted for soft saprophagy) and they are unable to consume any hard particles of food. It means, that food preferences may include liquid or subliquid organic contents of specific enzymatic qualifications (Stebnicka, 1985).

The morphological changes are always connected with function which a part of the body concerned has to perform. These modifications can be grouped as follows: 1/ rudimentation or disappearance of sclerites, 2/ displacement of sclerites, 3/ development of new parts in preexisting sclerites, 4/ transformation of organs or their portions, 5/ abnormal (hypertelic) development of organs. It is unclear whether these characteristics are important to the integration of the guests into host colonies since the supporting behavioural information is not available. Species of *Iarupea* possess humeral microtrichomes, however, their function may be suspected only. Long legs with relatively thick tarsi probably allow guests to keep up with their hosts. The ability to pull appendages and fore legs into ventral cavities most certainly has a defensive significance and allows the beetles to survive occasional aggressive reactions by their hosts. The functions of other specializations, for example the presence of elytral swellings or tubercles (glands?) are not at all clear.

The species of Eupariini listed in Table 1 have been observed in association with leaf-cutting (fungus growing) ants *Atta* Fabricius and *Acromyrmex* Mayr and with fire ants *Solenopsis* Westwood and *Iridomyrmex* Mayr (Myrmicinae). The distribution and biology of the gardening ants has been summarized by Weber (1972). Attini are widely distributed in America and have the largest colonies. Their fungus gardens consist mostly of vegetable material and insect fecal material to which the ants add saliva and liquid fecal droplets. The ants either cast out exhausted substrate and dead ants or store it in separate chambers of the nest, and these large volumes of decaying

TABLE 1: Eupariini species associated with termites and with ants *Atta* F., *Acromyrmex* Mayr, *Solenopsis* Westw. and *Iridomyrmex* Mayr (Myrmicinae)

Eupariini species	Host species	Locality	References
<i>Iarupea lopeteguii</i>	<i>Atta vollenweideri</i> nest gallery	Argentina, Prov. Formosa	Martinez, 1953
<i>I. attenuata</i>	<i>Atta sexdens</i>	Brazil, Minas Gerais	label data by Martinez
<i>I. serratipennis</i>	<i>Atta sexdens</i>	Brazil, Mato Grosso do Sul	label data by Steinbach
<i>I. goias</i> sp. n.	<i>Atta</i> sp. nest gallery	Brazil, Goiás	label data by Bancovics
<i>I. luisae</i> sp. n.	<i>Atta</i> sp. dump, mangrove area	Brazil, São Luis Island	label data by Bergmann
<i>Euparia castanea</i> /E. <i>mirabilis</i>	<i>Solenopsis xyloni</i> , <i>S. geminata</i>	Southern USA	Wojcik <i>et al.</i> , 1977
<i>Arupaia friedenreichi</i>	<i>Solenopsis geminata</i>	Brazil, Santa Catarina	label data by Triplehorn
<i>Selviria matogrossoensis</i>	<i>Solenopsis invicta</i>	Brazil, Goiás	label data by Morgante & Silva
<i>Euparixia duncani</i>	<i>Acromyrmex versicolor</i>	USA (Arizona)	Woodruff & Cartwright, 1967
<i>E. moseri</i>	<i>Atta texana</i>	USA (Louisiana)	Woodruff & Cartwright, 1967
<i>E. bruneri</i>	<i>Atta insularis</i>	Cuba	Woodruff & Cartwright, 1967
<i>E. formica</i>	<i>Atta mexicana</i>	Mexico	Woodruff & Cartwright, 1967
<i>E. costaricensis</i>	<i>Atta colombica</i> , <i>A. cephalotes</i>	Costa Rica	Woodruff & Cartwright, 1967
<i>E. campbelli</i>	<i>Atta</i> sp.	Guatemala	Gordon & McClellan, 2003
<i>Lomanoxia costulata</i>	<i>Atta sexdens</i>	Surinam	Krikken, 1972
<i>L. alternata</i>	<i>Atta cephalotes</i>	Surinam	Krikken, 1972
<i>L. canthonopsis</i>	<i>Atta cephalotes</i>	Costa Rica	Skelley & Howden, 2003
<i>Flechtmanniella laticollis</i>	<i>Acromyrmex lobicornis</i>	Brazil, São Paulo	label data by Martinez
<i>Lomanoxoides nigrolineatus</i>	<i>Atta colombica</i>	Panama	Stebnicka & Skelley, 2005
<i>L. tesari</i>	<i>Atta sexdens</i>	Paraguay	Stebnicka, 1999a
<i>Paraplesiataenius tremolerasi</i>	<i>Acromyrmex lobicornis</i> <i>A. lundii</i>	Argentina Uruguay	Chalumeau, 1992 label data by Fernandez
<i>P. catarinaensis</i>	<i>Acromyrmex</i> sp.	Brazil, Santa Catarina	Stebnicka, 2003a
<i>P. genieri</i>	<i>Acromyrmex</i> sp.	Brazil, Bahia	Stebnicka, 2003a
<i>Martineziella vandykei</i>	<i>Solenopsis invicta</i>	Mexico	label data by Stinger
<i>Martineziella dutertrei</i> (=Myrmecaphodius excavaticollis)	<i>Solenopsis invicta</i> , <i>S. richteri</i> , <i>S. geminata</i> , <i>S. xyloni</i> , <i>Iridomyrmex</i> <i>humilis</i>	USA (Alabama, Florida, Georgia, Louisiana, Mississippi, Texas)	Wojcik <i>et al.</i> , 1977
<i>Myrmecaphodius proseni</i>	<i>Solenopsis saevissima</i>	Argentina, Buenos Aires	Martinez, 1952
<i>Haroldiataenius hintoni</i>	<i>Atta mexicana</i>	Guatemala	Saylor, 1933
<i>H. limbatus</i>	<i>Atta</i> sp.	Guatemala	label data by Baster
<i>Ataenius holopubescens</i>	<i>Atta mexicana</i>	Mexico	Stebnicka, 2003b
<i>A. variopunctatus</i>	<i>Solenopsis</i> sp.	Argentina	Stebnicka, 2005
<i>Batesiana tuberculata</i>	"termites"	Brazil	label data by Degallier
<i>Napoa peckorum</i>	"broken termite nest"	Ecuador	Stebnicka, 1999d

refuse may attract the beetles. The fire-ants *Solenopsis* form populous colonies usually in open soil localities, often on pastures under cow dung and often in close proximity to the nests of large ants from whom they steal brood and other food (Moody & Franke, 1982).

Judging from the rather scarce collection data, the beetles exploit either abandoned mounds of ants and the active colonies. The small euparine beetles visiting or living in the colonies of ants are practically defenceless, in particular in the nests of *Solenopsis*, the workers of which are extremely aggressive and possess a painful sting. Kistner (1979) has identified a number of mechanisms that enable the integration of guests into host colonies, for example the guests may use chemical means and mimic chemical communication systems of the hosts. Collins & Markin (1971) recorded *Martineziella dutertrei* from 98% of the fire ant nests they examined in the United States and they observed in the laboratory that the beetles in nearness of ants released a strong musky odour. It seems most likely that either the ants and beetles may produce, in some conditions, the integrative pheromones, for example, the beetles may be attracted by odorous secretion, a glandular substantia skatole/indole (Brown *et al.*, 1979; Keegans *et al.*, 1993) used by hosts to mark their trails. The integrative mechanisms are complicated and very difficult to explain, however, the most important factor which lures beetles to the nests of ants is that the large host colonies have a higher diversity of microhabitats and sources of food. The vast amounts of decomposing vegetable matter collected and discarded by ants constitute nutritionally richest resource for saprophagous beetles of Eupariini, therefore, their possible role of the nests cleaners may be tolerated or accepted by hosts.

The development of fungus-gardens of both ants and termites was probably one of the factors which led to extensive invasion of their nests by various beetles in later times.

ACKNOWLEDGEMENTS

I am grateful to Henry F. Howden from the Canadian Museum of Nature for his invaluable cooperation as well as to the following persons for their assistance: F. Génier (Ottawa), P.E. Skelley (Florida), O. Merkl (Budapest), I. Löbl, G. Cuccodoro and B. Merz (Geneva), Y. Cambefort (Paris), D. Ahrens (Dresden), †N. Adams, D. Furth and G. House (Washington), H. Wendt (Berlin). I wish to thank Marek Kopeć from ISEA Krakow for making the photographs of beetles.

REFERENCES

- BALTHASAR, V. 1945. De uno Genere et nonnullis Aphodiinarum speciebus novis. *Časopis Československe Společnosti Entomologické* 42: 104-115.
- BALTHASAR, V. 1963. Eine neue Gattung, Untergattung und neue Arten der Familie Aphodiidae. *Reichenbachia* 1: 277-290.
- BATES, H.W. 1887. Col.:Lam. (Copridae, Aphodiidae, Orphnidae, Hybosoridae, Geotrupidae, Trogidae, Aclopidae, Chasmatopteridae, Melolonthidae). *Biologia Centrali-Americana. Insecta* 2: 26-160.
- BROWN, C.A., WATKINS, J.F. & ELDRIDGE, D.W. 1979. Repression of bacteria and fungi by the army ant secretion: skatole. *Journal of the Kansas Entomological Society* 52: 119-122.
- BROWN, W.J. 1927. Two New North American Genera of the Tribe Eupariini. *Canadian Entomologist* 59: 288-290.

- CARTWRIGHT, O. L. 1973. Additional lectotype designations in the Aphodiinae. *The Coleopterists Bulletin* 27: 41-43.
- CARTWRIGHT, O. L. 1974. *Ataenius*, *Aphotaenius* and *Pseudataenius* of the United States and Canada. *Smithsonian Contributions to Zoology* 154: 1-106.
- CHALUMEAU, F. 1981. Nouveau genre et sous-genres d'Eupariini d'Amérique tropicale. *Nouvelle Revue d'Entomologie* 11: 137-142.
- CHALUMEAU, F. 1983. *Batesiana* et *Martinezia*, nouveaux genres d'Eupariini du nouveau monde. *Bulletin mensuel de la Société linnéenne de Lyon* 52: 142-153.
- CHALUMEAU, F. 1986. *Martineziella* nomen novo pour *Martinezia* Chalumeau. *Nouvelle Revue d'Entomologie* 3: 386.
- CHALUMEAU, F. 1992. Eupariini du nouveau monde: un mise au point. 1^{re} Partie. *Nouvelle Revue d'Entomologie* 9: 189-206.
- CHALUMEAU, F. & HOWDEN, H.F. 1984. Le genre *Euparia* Saint-Fargeau & Serville, 1828. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 57: 85-94.
- CHAPIN, E.A. 1940. A revision of the West Indian beetles of the Scarabaeid subfamily Aphodiinae. *Proceedings of the United States national Museum* 89: 1-41.
- COLLINS, H.L. & MARKIN, G.P. 1971. Inquilines and other arthropods collected from nests of the imported fire ant, *Solenopsis saevissima richteri*. *Annals of the entomological Society of America* 64: 1376-1380.
- GORDON, R.D. & MCCLEVE, S. 2003. Five new species of *Euparixia* Brown (Coleoptera: Scarabaeidae: Eupariinae), with a revised key to species. *Proceedings of the entomological Society of Washington* 105: 685-697.
- HAROLD, E. 1867. Diagnosen neuer Coprophagen. *Coleopterologische Hefte* 1: 76-83.
- HAROLD, E. 1870. Die Arten der Gattung *Euparia*. *Coleopterologische Hefte* 6: 19-30.
- HINTON, H.E. 1934. Two genera of Aphodiinae new to Mexico. *The Pan-Pacific Entomologist* 10: 27-30.
- HINTON, H.E. 1936. A new species of *Ataenius* from Mexico. *Revista de Entomologia* 6: 472-474.
- HINTON, H.E. 1938. New species of Neotropical Aphodiinae. *Revista de Entomologia* 8: 122-129.
- KEEGANS, S. J., BILLEN, J., MORGAN, E.D. & GÖKEEN, O.A. 1993. Volatile glandular secretions of three species of new world army ants: *Eciton burchelli*, *Labidus coecus* and *Labidus praedator*. *Journal of Chemical Ecology* 19: 2705-2719.
- KISTNER, D.H. 1979. Social and evolutionary significance of social insects symbionts (pp. 340-413). In: HERMAN, H.R. (ed.). *Social insects*. Academic Press: New York & London.
- KRIKKEN, J. 1972. Species of the South American genus *Lomanoxia* (Coleoptera: Aphodiidae). *Studies on the fauna of Suriname and other Guyanas* 13: 68-83.
- LE PELETIER DE SAINT-FARGEAU, A.L.M. & AUDINET-SERVILLE, J. G. A. 1828. Scarabé (pp. 346-382). In: LATREILLE, P. A. (ed.). *Histoire Naturelle. Entomologie, ou Histoire Naturelle des Crustacés, des Arachnides et des Insectes. Encyclopédie Méthodique*. Paris (Agasse) 10.
- MARTÍNEZ, A. 1951. Scarabaeidae nuevos o poco conocidos. II. *Publicaciones Misión de Estudios de Patología regional argentina* 22: 23-36.
- MARTÍNEZ, A. 1952. Scarabaeidae nuevos o poco conocidos. III. *Publicaciones Misión de Estudios de Patología regional argentina* 23: 53-118.
- MARTÍNEZ, A. 1953. Scarabaeidae nuevos o poco conocidos. IV. *Publicaciones Misión de Estudios de Patología regional argentina* 24: 69-85.
- MOODY, J.V. & FRANCKE, O.F. 1982. The Ants (Hymenoptera, Formicidae) of Western Texas, Part I: Myrmicinae. *Graduate Studies Texas Tech University* 27: 1-80.
- PETROVITZ, R. 1973. Neue Aphodiinae, Hybosorinae und Acanthocerinae aus der Neotropischen Region. *Studia entomologica* 16: 141-202.
- SAYLOR, L.W. 1933. Two new Scarabaeidae. *Canadian Entomologist* 65: 158-159.
- SCHMIDT, A. 1911. Eine Serie neuer Aphodiinen. *Stettiner entomologische Zeitung* 72: 1-51.

- SCHMIDT, A. 1922. Coleoptera, Aphodiinae. *Das Tierreich*, Vol. 45. Walter de Gruyter and Co., Berlin und Leipzig, 614 pp.
- SKELLEY, P.E. & HOWDEN, H.F. 2003. A new species of *Lomanoxia* Martínez from Costa Rica (Coleoptera: Scarabaeidae: Aphodiinae). *Insecta Mundi* 17: 185-190.
- STEBNICKA, Z. 1985. A new genus and species of Aulonocneminae from India with notes on comparative morphology (Coleoptera: Scarabaeidae). *Revue suisse de Zoologie* 93: 649-658.
- STEBNICKA, Z. 1999a. Neotropical Eupariini: New and little known genera and species (Coleoptera: Scarabaeoidea: Aphodiinae). *Revue suisse de Zoologie* 106: 285-300.
- STEBNICKA, Z. 1999b. *Flechtmanniella*, a new name for *Flechtmannia* Stebnicka, 1999. *Acta zoologica cracoviensis* 42: 287.
- STEBNICKA, Z. 1999c. *Lomanoxia* Martínez, 1951, and a new tribe Lomanoxiini with notes on comparative morphology (Coleoptera: Scarabaeoidea: Aphodiinae). *Acta zoologica cracoviensis* 42: 279-286.
- STEBNICKA, Z. 1999d. A new genus and species of termitophilous Eupariini from Ecuador with checklist of the Neotropical genera (Coleoptera: Scarabaeoidea: Aphodiinae). *Acta zoologica cracoviensis* 42: 289-295.
- STEBNICKA, Z. T. 2001. Aphodiinae (Insecta: Coleoptera: Scarabaeidae). In: *Fauna of New Zealand* vol. 42, 64 pp, Manaaki Whenua Press, Lincoln Canterbury.
- STEBNICKA, Z. 2003a. The genus *Paraplesiataenius* Chalumeau, with descriptions of two new species from Brazil (Coleoptera: Scarabaeidae: Eupariini). *The Coleopterists Bulletin* 57: 444-450.
- STEBNICKA, Z. 2003b. The New World species of *Ataenius* Harold, 1867. III. Revision of the *A. imbricatus*-group sensu lato (Coleoptera: Scarabaeidae: Aphodiinae: Eupariini). *Acta zoologica cracoviensis* 46: 219-249.
- STEBNICKA, Z. 2005a. A Second Species of *Selviria* Stebnicka from Brazil (Coleoptera: Scarabaeidae: Eupariini). *The Coleopterists Bulletin* 59: 23-25.
- STEBNICKA, Z. 2005b. The New World species of *Ataenius* Harold, 1867. VI. Revision of the *A. aequalis-platensis*-group (Coleoptera: Scarabaeidae: Eupariini). *Acta zoologica cracoviensis* 48B: 99-138.
- STEBNICKA, Z., & HOWDEN, H.F. 1996. Australian Genera and Species in the Tribes Odontolochini, Psammodiini, Rhyparini, Stereomerini and Part of the Eupariini (Coleoptera: Scarabaeoidea: Aphodiinae). *Invertebrate Taxonomy* 10: 97-170.
- STEBNICKA, Z. & SKELLEY, P.E. 2005. Review of some New World aphodiine genera and descriptions of new species (Coleoptera: Scarabaeidae: Aphodiinae). *Acta zoologica cracoviensis* 48B: 23-42.
- VAZ DE MELLO, F.Z., LOUZADA, J.N.C. & SCHROEDER, J.H. 1998. New Data and Comments on Scarabaeidae (Coleoptera: Scarabaeoidea) Associated with Attini (Hymenoptera, Formicidae). *The Coleopterists Bulletin* 52: 209-216.
- WEBER, W.A. 1972. Gardening Ants. The Attines. *Memoirs of the American Philosophical Society* 92: 1-146.
- WOJCIK, D.P., BANKS, W.A. & HABECK, D.H. 1978. Fire ant myrmecophiles: flight periods of *Myrmecaphodius excavaticollis* (Blanchard) and *Euparia castanea* Serville (Col. Scarabaeidae). *The Coleopterists Bulletin* 32: 59-64.
- WOJCIK, D.P., BANKS, W.A., HICKS, D.M. & SUMMERLIN, J.W. 1977. Fire ant myrmecophile: new hosts and distribution of *Myrmecaphodius excavaticollis* (Blanchard) and *Euparia castanea* Serville. *The Coleopterists Bulletin* 31: 329-334.
- WOODRUFF, R.E. 1973. The Scarab Beetles of Florida. Part.I. The Laparosticti. Subfamilies: Scarabaeinae, Aphodiinae, Hybosorinae, Ochofdaeinae, Geotrupinae, Acanthocerinae. *Arthropods of Florida and Neighboring Land Areas* 8: 1-220.
- WOODRUFF, R.E., CARTWRIGHT, O.L. 1967. A Review of the Genus *Euparixia* With Description of a New Species From Nests of Leaf-Cutting Ants in Louisiana (Coleoptera: Scarabaeidae). *Proceedings of the United States National Museum* 123: 1-21.